The sweet and the bitter

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Title of the article: The sweet and the bitter: intertwined positive and negative social impacts of a biodiversity offset

Abstract:

Major developments, such as mines, will often have unavoidable environmental impacts. In such cases investors, governments, or even a company's own standards increasingly require implementation of biodiversity offsets (investment in conservation with a measurable outcome) with the aim of achieving 'no net loss' or even a 'net gain' of biodiversity. Where conservation is achieved by changing the behaviour of people directly using natural resources, the offset might be expected to have social impacts but such impacts have received very little attention. Using the case study of Ambatovy, a major nickel mine in the eastern rainforests of Madagascar and Ambatovy, a company at the vanguard of developing biodiversity offsets, we explore local perceptions of the magnitude and distribution of impacts of the biodiversity offset project on local wellbeing. We used both qualitative (key informant interviews and focus group discussions) and quantitative (household survey) methods. We found that the biodiversity offsets, which comprise both conservation restrictions and development activities, influenced wellbeing in a mixture of positive and negative ways. However, overall, respondents felt that they had suffered a net cost from the biodiversity offset. It is concerning that benefits from the development activities do not compensate for the costs of the conservation restrictions, that those who bear the costs are not the same people as those who benefit, and that there is a mismatch in timing between the immediate restrictions and the associated development activities which take some time to deliver benefits. These issues matter both from the perspective of environmental justice, and for the long term sustainability of the biodiversity benefits the offset is supposed to deliver.

Key-words: Madagascar, protected area, environmental justice, mining, sustainable development, forest use

Key Messages:

Biodiversity offsets are used to address environmental impacts of development; although offsets are spreading their social impacts have received little attention.

Using a biodiversity offset project in Madagascar we highlight the intertwined positive and negative impacts on local wellbeing.

Positive impacts include development projects provided by the offset project, but they are perceived to be too little and too late to compensate for conservation restrictions.

Those who suffer the greatest negative impacts from the conservation restrictions are not those who receive the most development investment.

Consideration of social impacts matters for sustainability of offsets and justice.

"*Io sahala amin'ny fiainana rehetra ihany hoe misy tsara, misy ratsy, misy mangidy, misy mamy*."

"It [the biodiversity offset project] is like life: there is good, there is bad, there is sweet and there is bitter." (interview, site B)

1. INTRODUCTION

Biodiversity offsets are a new mechanism which aims to compensate for any residual impacts of an infrastructure project on the environment (after efforts have been made to minimise them as far as possible) (McKenney and Kiesecker 2010), allowing economically important development to go ahead while ensuring that biodiversity and ecosystem services are conserved (Gardner et al. 2013b). The approach involves investing in "biodiversity gains" to make up for "unavoidable impacts" and has been used to address perceived business risk regarding biodiversity loss arising from projects such as mines, housing developments and roads (Hanson et al. 2012). Developed initially as a voluntary initiative in high income countries (ten Kate et al., 2004), this mechanism is rapidly being taken up around the world where major investments have the potential to have negative impacts on the environment. In developing countries, biodiversity offsets are now sometimes required by the International Finance Corporation (2012) and have been incorporated into the legal frameworks of a number of countries such as Brazil, India and China (The Biodiversity Consultancy 2013). Biodiversity offsets have been designed to compensate the biodiversity impacts of development. Discussion about the advantages and disadvantages of the approach therefore focuses mostly on the calculation, methods and rationale of measuring biodiversity loss and gains (Virah-Sawmy et al. 2014; Watson et al. 2010; Temple et al. 2012; Curran et al. 2014; Neimark and Wilson 2015; Moreno-Mateos et al. 2015; Maron et al. 2015; Quétier and Lavorel 2011; Walker et al. 2009; Bidaud et al. 2015) with relatively little focus so far on social issues (Benabou 2014). Furthermore, the limited social research on biodiversity offsets mainly considers case studies in the US or the UK (Sullivan and Hannis 2015; Hannis and Sullivan 2012; Robertson 2004, 2000) with very few case studies in developing countries (Seagle 2012; Kraemer 2012)

The social impacts of biodiversity offsets are likely to be very different in low and high income countries for several reasons. The legal contexts are different, with biodiversity markets widespread and well-regulated in USA, Australia and some other high income countries, while voluntary initiatives predominate in Africa (Madsen et al. 2011). The social contexts include very different levels of poverty. The environmental contexts are different as in many high income countries the conservation target may itself be the result of low intensity farming systems, whereas conserving relatively undisturbed habitats is the focus in many low income countries. Finally dependence on natural resources and ecosystem services for subsistence may be generally higher among rural people in low income countries than in more developed contexts.

In developing countries, biodiversity offsets generally compensate for the impacts of development on biodiversity by slowing the rate of biodiversity loss at sites not being developed relative to what might be expected to occur in the absence of the activities of the biodiversity offset project. Where the threats targeted by a biodiversity offset project are linked to local livelihood activities, they therefore depend on changing local people's behaviour and thus have the potential to impact local people's wellbeing, especially where people rely heavily on natural resources for their daily subsistence. For example, negative impacts may be felt by households who would have expanded agricultural land into the area designated as an offset. In this way biodiversity offsets have similar potential for negative social impacts as protected areas (Brockington and Igoe 2006).

Major developments receiving funding from multilateral financial institutions are committed to meeting a set of principles of good practice (known as the Equator Principles) which include consideration of social impacts. These recognise that livelihood costs which arise from internationally funded projects should be compensated, and that specific schemes must be developed for more "vulnerable" people, i.e. those with more precarious livelihoods (World Bank 2001 (updated in 2013); International Finance Corporation 2012). Thus people who are most heavily impacted by a project (in the context of biodiversity offsets this is those whose livelihoods depend on natural resources) should receive more and those who are more vulnerable should also have special consideration. Biodiversity

offset projects therefore initiate interventions to compensate for livelihood restrictions and support people to shift towards livelihoods viewed by project proponents as more sustainable (Business and Biodiversity Offsets Programme (BBOP) 2009). The conservation activities of the biodiversity offset may also bring some indirect benefits through the conservation of locally valued ecosystem services. Understanding the magnitude and distribution of these costs and benefits is critical to determining the impact of biodiversity offsets on local wellbeing. We feel therefore that research to investigate the ways that biodiversity offsets can impact on local livelihoods and poverty is timely.

This paper presents a case study from Madagascar, a country with weak law enforcement capacity (particularly with respect to environmental laws) (Kull 2002), widespread poverty (UNDP 2014), biodiversity of global importance (Myers et al. 2000), and high subsistence dependence of the rural poor on natural resources and ecosystem services (Dawson and Ingram 2008). In the last decade biodiversity offsets have been expanding in Madagascar (Waeber 2012) due to the rapid expansion of mining, including in areas of globally important biodiversity (Cardiff and Andriamanalina 2007). We focus on the offsets established by the Ambatovy mine, a major nickel and cobalt mine in eastern Madagascar. The Ambatovy offset project has been used as an example of best practice in biodiversity offsets (von Hase et al., 2014) and is therefore an excellent case study for investigating the potential social impacts of offset mechanisms. We use the constituents of human wellbeing from the Millennium Ecosystem Assessment (2005) as a framework to consider the social impacts of the Ambatovy biodiversity offset project. We highlight local people's perceptions of the balance between the positive and the negative impacts of the biodiversity offset project, the distribution of these impacts among people, and the temporal distribution of costs and benefits.

2. METHODS

2. 1 Case study description

The Ambatovy mine is being developed by two mining companies: Ambatovy Minerals SA and Dynatec Madagascar SA. It is one of the biggest nickel mines in the world and represents the largest ever foreign investment (US$6.9 billion) into Madagascar; comprising 35% of total foreign direct

investment between 2006 and 2012 (World Bank, 2014). Madagascar is one of the poorest countries in the world, with 92% of people living on less than US$ 2 a day (World Bank 2014). Two years after the start of exploitation, nickel was the country's top export product, contributing jobs and a large amount of tax revenue (Ambatovy 2014a).

The mine will destroy 2065 ha of natural forest habitat in the mine footprint and along a 220 km pipeline which moves material from the mine to the coast for processing and export (von Hase et al., 2014). Acknowledging the importance of the biodiversity of this forest (Ambatovy 2007), and to comply with the International Finance Corporation guidance (as required by its lenders)[1], Ambatovy launched a biodiversity offset programme early in its development. Undertaken in collaboration with a partnership of NGOs and companies interested in biodiversity offsets, known as the Business and Biodiversity Offset Programme, the programme aims to compensate the negative impacts on forest and to "deliver no net loss and preferably a net gain, of biodiversity" (von Hase et al. 2014; Ambatovy and BBOP 2009) through a portfolio of conservation and restoration projects. We focus on the conservation projects which are located in places which the mine developers argue would, in the absence of the offset project, be lost due to degradation and land conversion by local people living around these sites (CAETIC Développement 2013). The biodiversity offset conservation projects are located in two areas: around the mine footprint and in the forest of Ankerena, 70 km to the East (Figure 1). The latter site has a soil type similar to that found within the mine footprint and was therefore expected to have very similar biodiversity to that found at the mine footprint site (von Hase et al. 2014; Ambatovy and BBOP 2009).

Ambatovy's biodiversity offset project has two types of activities: conservation restrictions and development activities. The conservation restrictions focus on preventing seven key activities in their biodiversity offset sites: forest clearing for agriculture, gold mining, poaching, illicit human occupation, timber extraction, non-timber forest product extraction, and livestock grazing in protected forests (Source: Ambatovy team presentation during a conservation committee meeting in Maroseranana in November 2014). The company conducts local outreach to ensure the population are

aware of the restrictions, employs local villagers to undertake regular monitoring to detect and assess trends in human pressures, and occasionally brings in the local police to enforce the restrictions.
Throughout the area all forested land is legally considered as state land, but an informal system of customary rights over forested land is still in operation (Muttenzer 2010). The sites vary in the degree to which forest-use activities were restricted before the arrival of the biodiversity offset project. Hunting of wild species in Madagascar is covered by national legislation and some species (for example all lemurs) have been protected since 1960 (Keane et al. 2010; Rakotoarivelo et al. 2011). Clearance of forest for swidden agriculture had been prohibited nationally since the 1950s but the ban was lifted after independence in 1960, enforced more strongly after 2002 and then relaxed again with the last national political crisis in 2009 (Pollini 2012). The extent to which both hunting and swidden agriculture legislation were enforced before the start of the biodiversity offset project varies between sites: the forest around the mine footprint lacked any legal conservation status before the mine started operating in the area in 2012, while Ankerana forest was gazetted as a special reserve in 1963 and is part of the Ankeniheny-Zahamena forest corridor which is one of a number of new protected areas with temporary status since 2005[2] and permanent status since April 2015[3]. The Government delegated the management responsibility of this forest corridor to the NGO Conservation International. Conservation International is relatively active around Ankerana where it has established some community forest management projects and implemented a range of development programmes.
In order to compensate local people for the costs of stopping forest-related activities, the biodiversity offset project brings development activities. Depending on the area, different options are proposed to local people; the degree of choice available varies from site to site. Development activities initiated by Ambatovy include: plant nurseries, donations of seeds, fertilizer or livestock (sometimes of novel varieties for the area), dam construction to irrigate rice fields, and training in agricultural or livestock-raising techniques.
Around the mine footprint Ambatovy conducts both conservation activities and development activities through local community forest management associations (called forest associations below). Where

these voluntary member organisations did not already exist, Ambatovy established them. Madagascar introduced its first law to allow community involvement in the management of forests in 1996 (Raik 2007) and most protected areas in Madagascar are now surrounded by areas managed by these forest associations (Gardner et al. 2013a). Although some forest associations exist around Ankerana, Ambatovy say they work with any villagers who are interested advice (Ambatovy local team discussion).

2.2 Data collection

Between October 2014 and November 2015 we conducted field work in four sites where Ambatovy is implementing its biodiversity offsets: two closely connected to the mine footprint (in the commune of Ambohibary, where the mine has already cleared a large area of forest, and in the commune of Morarano Gara, where the mine has so far only implemented offset activities), and two close to the more distant Ankerana biodiversity offset (both in the commune of Maroseranana). Field work was conducted primarily by CB, MR and a research assistant, with limited field input from JPGJ and KS. CB and JPGJ are not native Malagasy speakers but are comfortable in conversational Malagasy, both with more than ten years' each of experience of field work in rural Madagascar, while MR and the research assistant are native speakers.

Initially we spent 3 to 5 days at each site conducting key informant interviews and focus group discussions and building a sampling frame for the later household surveys. We then carried out a household survey with a stratified random sample of households at each site. After preliminary analysis, we returned to each site to present and discuss the results with a further round of focus groups discussion. We also conducted key informant interviews (and a single focus group) with stakeholders at the regional level and in the three communes. Details of data collection is provided in Table 1.

At site A people are affected by both the mine and the offset project and it was initially difficult to ask people to reflect on the impacts of forest conservation when the view from their village is of the once-

forested land that has now been cleared by the mine. However, through careful explanation we managed to separate the impacts of the mine from the impacts of the biodiversity offset project.

Our initial key informant interviews were carried out with local leaders (president of the *fokontany*[4], traditional leaders and presidents of associations) and teachers. These followed an interview guide with questions on local wellbeing, development projects and collaboration with Ambatovy, forest resource uses and new restrictions, observed changes and factors causing changes (see appendix 3).

The focus groups were organised with five to ten people brought together by local contacts and comprised both community elders and household heads. We generally did not separate men and women as we found that women were confident to speak in mixed groups. We asked questions on land use systems, ecosystem services, and participants' perceptions of Ambatovy's impacts on their wellbeing (see appendix 4 for focus group protocol). To discuss wellbeing impacts, we gave participants a series of photos capturing everyday activities (e.g. rice production, forest product harvesting, wage labour, etc.) and asked them how the mine influenced each activity. Using paper and different coloured pens, participants arranged the images to show the positive and negative impacts of the mine and the strength of the impacts (see appendix 5 for an example). These diagrams were useful for eliciting valuable discussion about the types of impacts and their magnitudes.

Malagasy culture has a strong tradition of using proverbs (*ohabolona*) to characterise the challenges of life and the human condition (Domenichini-Ramiaramanana 1983) and these play an important role in traditional debates. We asked respondents during interviews and focus groups to suggest proverbs which captured the general relationship between themselves and the mine and best described the biodiversity offset project.

For the household survey, we worked with the president of the *fokontany* and other key informants to construct a sampling frame of all households in each site. At each site we then randomly selected 30 households in the main village of the *fokontany* and 30 from the scattered hamlets and isolated households on the forest edge to explore how impacts are affected by access. At sites A and C we surveyed all the households we were able to find (n=27 and 24 respectively). Due to logistical

constraints we were not able to conduct the household survey in site D. The questionnaire was generally addressed to the household head but other household members were often present and joined in the discussion surrounding each question. The survey contained a standard household roster and information on poverty indicators. We used a range of poverty indicators selected for the rural Malagasy context (see Table 2) to reflect the fundamental needs as defined by the global multidimensional poverty index (i.e., education, health and standards of living) (Alkire et al. 2015). We also included questions about income-generating activities, forest use and experience of development activities (such as receipt of training or donations from external stakeholders) and how these three points had changed during the last five years (see appendix 1 and 2). The question on change was an open question, to see which factors of change people would highlight. Only the last section of the questionnaire directly mentioned Ambatovy's impacts. Here we showed interviewees the conceptual framework on biodiversity offset impacts drawn by the focus groups at their site (see appendix 5), and asked them to move the images and green and red arrows (representing positive and negative impacts) to reflect the impacts experienced by their own household. As income activities are varied and change over time, and it is difficult for people with relatively weak links to market economies to estimate their incomes, we investigate people's perceptions of the relative importance of impacts rather than attempting to value them monetarily. After carrying out preliminary analysis of the data collected we returned to the four communities to hold feedback meetings and validate our findings. We did this by projecting the results (in the form of pictures, graphs and some text) to focus groups and discussing them, as well as presenting the results more widely through a poster exhibition in the village (see appendix 6).

We also conducted 23 interviews at the regional level with key stakeholders working in conservation, government and/or mining, while we do not include detailed results from these interviews in this paper they provided valuable context and understanding which informed the design of other components of the research.

2.3 Ethical considerations

This research was approved under Bangor University's research ethics framework. Interviewees were informed of the aims of the research, how data would be treated and that all information would be anonymised. We made it clear that participation was voluntary and that they could leave an interview or focus group at any time. We provided a short leaflet in Malagasy explaining this with contact details and photographs of the field team. During the survey we gave small donations (e.g. a packet of candles with a lighter) to households to thank them for their time. We also gave a small gift to focus group participants. We did not compensate key informants for interviews, but some village key informants also worked for us as local guides or helped to develop the sampling frames and were then paid a day rate for their time.

We initially planned to do this research in close collaboration with Ambatovy but as we were not able to agree the terms of a memorandum of understanding our research was conducted fully independently of the mine. Because of the lack of a memorandum of understanding we were not able to interview Ambatovy staff nor to obtain any data from them which is not in the public domain. However this did leave us completely free from any real or perceived conflict of interest. At the end of our study, we presented our results to the Ambatovy team and received some limited feedback from them.

2.4 Data analysis

The interviews and focus groups were conducted in Malagasy and recorded in a notebook or using a digital recorder. Recordings were transcribed and translated into French and then coded for thematic analysis using NVivo software (Version 10). We organized issues raised in the broad and wide-ranging discussions in the focus groups about the impacts of the offset project using the five constituents of wellbeing from the Millennium Ecosystem Assessment (2005): health, basic material for a good life, security, freedom of choice and action, and good social relations.

The household survey results were entered into Excel and analysed with R (R Core Team 2015). The anonymised raw data is available from ReShare public data archive[5].

The indicators of poverty (see Table 2) were analysed using a principal component analysis (PCA) in the R psych package (Revelle 2015) based on polychoric & polyserial correlations estimated in the R

polycor package (Fox 2010). Input variables to the correlation matrix were measures of household food security, house size, house quality, access to power, water & health and education levels. The first two principal components, explaining 56% of variation, were then used as inputs into the regression models.

To explore the effect of the distance to the forest on poverty and on uses of forest resources, we plotted the data using the R ggplot2 package (Wickham 2009), combining the first wealth axis from the PCA, the distance to forest and the practice of swidden agriculture (locally known as *tavy*)[6] or the collection of wild products.

To investigate which variables (forest association membership, member of association committee, measures of poverty, distance to forest, wood exploitation, collection of wild products, gold mining, practice of swidden agriculture, or site) are the most important predictors of a household receiving training and material donations from the development activities of the offset project we carried out separate ordered logistic regressions with a binary response variable.

3. RESULTS

We first provide an overview of local poverty and context in the study sites. We then outline the ways in which respondents perceive that the biodiversity offset activities impact the constituents of wellbeing. We end with details of the magnitude and distribution of the positive and negative impacts of the biodiversity offset programme.

3.1 Poverty and livelihoods around Ambatovy's biodiversity offset sites

The Ambatovy biodiversity offset project is being implemented in sites where people are very poor. Access to education is limited; while 63% attended primary school only 7% attended secondary school. Access to health care is poor but has improved at sites A and B as Ambatovy had built a hospital and brought a doctor to the area once a week (who sees about 25 people). However, even here, people stated they would only go to the hospital if they had the money, which was not the case all year round. None of the sites are connected to the electricity grid and people mostly used petrol lamps (40%), torches (43%) or candles (11%) for light. Only very few had invested in a solar lamps

(3%) or a generator (3%). Access to water was mostly considered to be sufficient by respondents however facilities are extremely basic. At site C all households obtained water directly from a river, while at sites A and B approximately a quarter of households had access to private or community wells. No one has water piped to their home and water is not treated. At site A respondents complained that water was scarce during the dry season because of the mine's large dams and the fact that it took water from a river to feed its pipeline, which transports ore from the mine to the port. People had three rooms on average (usually comprising a bed/living room plus a separate kitchen and granary). We found that 60% of roofs across the sample were made of pandanus leaves, bamboo or grass thatch, while 40% were made of sheet metal (sheet metal was especially common at site B at 53%). On average families had sufficient rice for 7.5 months of the year (range 0-12). People in this area are primarily rice farmers (98% cultivate rice and for 80% it is their primary activity) but many do not grow sufficient to feed their families.

People use resources from the forest for many everyday necessities with 85% of respondents collecting wild products including wood, pandanus leaves, lianas and palms for house construction, other plants for weaving or medicinal use, wild fruits and tubers, or hunting fish and terrestrial animals. Wild food is especially important during periods of local food shortage. Wild products were collected for subsistence by 30% of households, for sale by 35% and for both subsistence and sale by 35%, with some households heavily involved in the trade. In all four sites there were an increasing number of households who mined for gold or precious stones in the forest (26% of all respondents said gold mining was currently one of their income activities, rising to 65% of respondents in site C). Many households (47%) reported clearing forest for swidden agriculture.

Our measures of poverty are not perfectly correlated but there were clear differences between sites, with site C being generally poorer than the other sites (and having particularly low access to education and irrigated rice-fields) (see Figure 2). Those living closest to the forest tend to be poorer however they are not consistently more reliant on collection of wild products or on swidden agriculture (Figure 3).

3.2 The mechanisms by which biodiversity offsets can impact local wellbeing

Local people perceived that both types of activities carried out by Ambatovy's biodiversity offset project (conservation restrictions and development activities) had impact on wellbeing (Figure 4). On the one hand, conservation restrictions were perceived to have a positive impact on the forest and thereby the potential to have a positive impact on health (through perceived impacts on air quality) and basic materials for a good life (by affecting water quantity). On the other, conservation restrictions were perceived to negatively impact basic material for a good life and freedom of choice and action. The conservation restrictions were also seen as having both positive and negative impacts on security: some suggested that the increased presence of police brought in by the mine to enforce restrictions improved security. However others were fearful of the police and complained that they abused their powers for example by stealing chickens (this has worrying echoes of literature demonstrating how conservation can be used to legitimise the use of violence against local people (Peluso 1993). Some respondents felt that their village was more insecure because people were struggling financially due to the conservation restrictions and therefore more likely to steal from others.

Development activities were considered to have a positive impact on basic material for a good life and a negative impact on good social relations (as conflicts arose around the distribution of training activities and donations). In the following sections, we present more information on the positive and negative impacts on the two components of wellbeing that most frequently discussed: basic material for a good life and good social relations.

3.2.1 Impacts of biodiversity offsets on basic materials for a good life

Local people perceived that conservation restrictions had the potential to have a positive impact on the forest and thus on the quantity of water available for agriculture and the productivity of the irrigated rice fields. At site B, focus group participants stated that "The benefit from the forest is …. it provides water. If we cut the forest the land becomes arid and brings sickness because of lack of rain. This is

why it is important to manage the forest well". Villagers at site D agreed, highlighting in particular that "the forest is important because it brings water for the lands and for the rice fields".

The development activities were also seen to positively impact availability of basic materials for a good life (Table 3). Of 170 respondents, 66 had received training from the offset project (a total of 100 separate training events were reported ranging from agricultural techniques and raising livestock to forest management). Of these, 61% were considered to have had a positive impact on the household within the short or long term. Material donations (chickens, agricultural equipment or fruit tree seedlings) from the offset project had been received by 77 respondents, with 57% of recipients reporting these had a positive impact on the household while another 28% considered the donations had the potential for having a positive impact in the future. Considering the difficulties of development activities in the context of rural Madagascar, these results show that the project's efforts are considered worthwhile by the people they reach.

However, the conservation restrictions also had a clear and widely reported negative impact on many people's ability to procure basic materials for a good life as they restrict people's opportunity to use the forest for agricultural expansion or collection of wild harvested products for subsistence use or sale. People were particularly concerned about restrictions on land expansion, which they felt exacerbated existing pressure on land availability caused by population increase. Villagers at site D explained that "People give birth and get more numerous while the land is getting smaller". They went on to complain that this limited their options, "before people used to work the land where they wanted to. Now they can't go anywhere. They have only one land and can't work in other places".

By enforcing prohibitions on clearing new land for agriculture and preventing the use of fire for clearing invasive species, the conservation restrictions of the biodiversity offset were perceived to have a negative impact.

3.2.2 Impacts of the biodiversity offset on social relations

Both the conservation restrictions and the development activities are perceived to have had negative impacts on social relations. In some sites the enforcement of the conservation restrictions operates

through the local forest association and committee members are expected to report any forbidden activities. They can impose fines and, if necessary, report the offender to the *fokontany*, the commune, or even the regional level where a larger fine or a prison sentence may be imposed. By encouraging and empowering some people to report on their neighbours, the offset project has introduced new social tensions. As explained by a forest association member at site D, "there are new conflicts as people are angry with Ambatovy but, as you are protecting the forest, people get angry with you too because you are working with Ambatovy". However, the biggest source of social tension appears to be conflicts related to the growing pressure on land, especially in sites C and D where there is no flat land for irrigated rice fields and where all people practice swidden agriculture.

Because livelihoods vary, the conservation restrictions did not impact everyone in the same way. Some people felt strongly that they had suffered from the conservation restrictions but had not had the opportunity to benefit from the development activities. This perception is supported by our quantitative data. Of the material donations reported by respondents, 50% were received by people living near the *fokontany* centre and 40% by people living in hamlets closer to the forest (Table 4). This is despite the fact that fines for breaking conservation restrictions are much more likely to have affected those near the forest (21%) than those living in the *fokontany* centre (4%). The most important predictors of a household receiving training or material donations was not uses of the forest (indicated by variables such as distance to forest, wood exploitation, collection of products from the wild, gold mining, practising swidden agriculture) or poverty (as estimated by our two poverty axis from the PCA), but rather being a member or a decision-making member of the forest management association (see Figure 5).

The mayor of one of our study communes used the proverb "*Those close to the cooking pot get covered in soot"*[7] to make the point that some people are in a better position (due to their social or family connections) than others to benefit from the development activities brought by the biodiversity offset project.

3.3 The magnitude and distribution of positive and negative impacts of biodiversity offsets on wellbeing

When considering all the various ways in which the Ambatovy biodiversity offset provided positive and negative impacts, people generally reported a negative impact on their own household (85%). However at larger scales (village and national scale) the balance between positive and negative impacts changed and 52% considered that overall the biodiversity offset project had a positive impact for Madagascar as a whole (see Figure 6). The reasons given for positive impacts at larger scale were the importance of forest conservation - expressed as a general idea that forest protection is good without any reason given (36%), for the provision of rain and water (4%) or the future use of the forest (6%).

The reasons for negative overall impacts at the household scale were perceived inequalities in costs and benefits, the general dissatisfaction with the magnitude of the benefits and the temporal mismatch between the immediate restrictions and the delayed benefits from development activities.

3.3.1 Dissatisfaction with the magnitude of the benefit from the development activities

Respondents were generally dissatisfied with the magnitude of the benefits that could be obtained from the development activities. At site A they used a proverb to clarify that the meagre benefit was "*like the neck of a chicken, you eat it and choke on a bone, you leave it, you are leaving good meat"*[8]. A second proverb, "*It is like a kite [bird of prey] who caught a tortoise, he caught it but did not gain anything*"[9] referred to a tortoise's habit of pulling in its legs when threatened. Thus, a bird of prey (the villagers) might be unable to actually obtain the promised benefits despite catching the tortoise (the Ambatovy offset project).

There was a general dissatisfaction, therefore, that the benefits from the development activities were not only disappointing relative to the negative impacts caused by the conservation restrictions, but also relative to people's expectations. This feeling was particularly marked in the sites close to the mine footprint (A and B) where the importance and power of the mining company is particularly visible.

3.3.2 Temporal mismatch between the restrictions and the development activities

A particular problem raised by respondents was that the negative impacts of the offset were felt well before any positive ones. For example, promotion of perennial crops (through training and donations of fruit tree seedlings) was widely perceived as having the potential to bring benefits, but only when the trees matured, while the restrictions were in place right away. One member of the forest management committee at site A explained that "this is the problem with Ambatovy: they forbid first and give an alternative only once people are in difficulty". This interviewee went on to explain that the local population could not invest time in new development activities brought by Ambatovy (e.g. foie gras production) as the need to feed their family every day forced them to turn to casual labour rather than investing time in activities with potential longer-term returns. This concern about the time delay between the negative impacts (experienced from the beginning of the programme) and the positive ones (anticipated in the future) was common to all sites.

4. DISCUSSION: WHY BIODIVERSITY OFFSET SCHEMES NEED TO RAISE SOCIAL ISSUES

Biodiversity offsets are intended to help address the trade-off between economic growth and conservation. The Ambatovy mine is of great importance to the national economy; providing salaries, tax revenue and infrastructure development (Ambatovy 2014b). In order to meet the 'no net loss' or 'net gain' of biodiversity requirements of national policies and international standards, the mine has developed ambitious projects to compensate for its impact on biodiversity by supporting conservation of threatened habitats and species elsewhere in eastern Madagascar.

There is a well-developed literature concerning the impacts of conservation restrictions in the context of protected areas on local people's wellbeing (Milner-Gulland et al. 2014; Agarwala et al. 2014). Although biodiversity offsets have been developed by different actors, they share objectives with many protected areas (reducing local people's agricultural expansion or collection of wild resources) and therefore have similar potential social impacts (Benabou 2014).

We have shown that the Ambatovy biodiversity offset project has intertwined positive and negative impacts on all five constituents of wellbeing. We argue that there are two important reasons why

social issues need to be more carefully considered in the design of biodiversity offset schemes such as Ambatovy: 1) because of concern for environmental justice, 2) for pragmatic reasons concerned with success in delivering biodiversity benefits long term.

4.1 Environmental justice

It is increasingly recognised that the distribution of ecological burdens and benefits is unequal; with poorer and less politically powerful communities or individuals disproportionately suffering from pollution (Ma 2010), or conservation restrictions (Angelsen et al. 2014). Biodiversity offsets aim to avoid extinction of threatened species and protect rare habitats. Of course local people may value such conservation but the benefits are also felt globally (Balmford and Whitten 2003).

We demonstrate that local people recognise the overall benefits of forest conservation to Madagascar. However they feel that, for their village and household, the dominant impacts of biodiversity offset projects are negative because of the restrictions on land use and because the compensation offered is less than the opportunity costs. We would therefore argue that rural communities living on the edge of Madagascar's rainforest are bearing the cost of allowing the mine development (which brings economic benefits to Madagascar) while conserving the forest (which brings global benefits). Therefore this is an environmental justice issue at the global scale.

Furthermore, injustice can be exacerbated within communities, with households bearing the greatest conservation-related costs not necessarily benefiting from the development activities on offer. Our research confirms findings that conservation projects may reinforce inequalities in access to natural resources and decision making (Corbera et al. 2007)

At local level, communities are not undifferentiated. The group who would be identified by outsiders as local and affected by the offset project are very heterogeneous in terms of their use of the forest and wealth status. According to both national policies (Ministère de l'environnement de l'écologie et des forêts, Banque Mondiale, and Unité de coordination des projets environnementaux 2014; Republique de Madagascar 2003) and international standards (International Finance Corporation 2012; Business and Biodiversity Offsets Programme (BBOP) 2009), development activities should be targeted at

those who bear an opportunity cost from the conservation restrictions imposed by the project. For instance, the World Bank states that measures should be identified to "assist [economically displaced] persons in their efforts to improve their livelihoods, or at least to restore them, in real terms, while maintaining the sustainability of the park or protected area" (World Bank 2001 (updated in 2013)). There is also a general principle that special consideration should be given to those who are most vulnerable (for example due to poverty). This is explicitly recognised in the Malagasy national law for new protected areas, which states that protected areas must reduce poverty (Madagascar 2015). Unfortunately despite these good intentions, this is not what we observe. Household livelihood activities are in most cases not a significant predictor of whether the household receives help from the development activities; in fact, the opposite tends to be true, with households that practise more swidden agriculture being less likely to receive development assistance. There is no effect of poverty status on a household's likelihood of receiving material donations but the richer households tend to have received development-related training. The strongest predictor of both types of development assistance (material donations and training) is an individual being a member of the forest management association, and especially a committee member. In rural eastern Madagascar this appears to be a proxy for social status and connectedness (Poudyal et al. 2016). Elsewhere in Madagascar, similar findings have been reported for activities developed by conservation NGOs (Brimont et al. 2015), World Bank-funded social safeguard compensation (Poudyal et al 2016)and other biodiversity offset projects (Kraemer 2012).

4.2 To ensure sustainability of the biodiversity benefits

Some interviewees at national level argued that Ambatovy has no legal requirements to compensate local people for what are essentially illegal livelihood activities as the offset sites are in protected areas in which the use of forest is already legally constrained. However, following this line of argument to its logical conclusion would suggest that the whole biodiversity offset project is not valid as it does not meet the requirement of providing additional conservation, i.e. conservation which only comes about as a result of the project. To put it simply: if the forest is already conserved then there are no

biodiversity benefits from the offset, if there are "threats" to be stopped then there must be social costs from the project. The contradictions inherent in ensuring additionality from an offset project in areas which are already legally protected have been recognised Benabou (2014) who describes this as a 'tightrope exercise'.

In a low income country such as Madagascar, with high levels of poverty, heavy dependence on natural resources and few economic alternatives, the conservation outcome of biodiversity offsets will only be achieved and be sustainable if the livelihood alternatives offered are indeed effective. Given the number of livelihood activities relying on forest resources (legal as well as illegal, subsistence as well as commercial) and the cultural significance of forest based livelihoods (Desbureaux and Brimont 2015) this is extremely challenging. BBOP suggests that projects take a pragmatic approach and, if economic incentives are needed to shift local people's livelihoods away from what is considered "unsustainable", then these can be justified as an offset activity (Business and Biodiversity Offsets Programme (BBOP) 2009, p51).

Lessons learnt from this case study

In general we found that the type of development activities provided by Ambatovy were well received locally and well implemented with a high proportion of respondents feeling that they delivered benefits or had the potential to deliver benefits in the future. Nevertheless there remains a mismatch between who benefits from the development activities and who bears the cost of the conservation restrictions. Such issues of distributive inequity at local level arising from, or exacerbated by, new ecosystem service governance scheme have been highlighted in the literature (McDermott et al. 2013; Sikor et al. 2014), although little information is available on local framings of justice in this context (Martin et al. 2014).

A second and significant issue is the temporal mismatch between the conservation restrictions (implemented immediately at the start of the project), and the time when the benefits start to flow from the development activities. In the Ambatovy case, many of the development activities introduced have delayed benefits (fruit or coffee production) and the ability of local people to take advantage of the

new development activities was undermined by the immediate impacts of the conservation restrictions which forced them to take the short-term approach of investing their efforts in casual labour.

There has been a lot of criticism of biodiversity offset projects because of uncertainty about whether they will deliver the promised biodiversity benefits due to management failure or an external threat such as other developments or climate change (Gardner et al. 2013b). The time delay between the ecological costs (of the degradation occurring at the beginning of the project) and biodiversity benefits (often achieved decades later) has also been criticised (Curran et al. 2014; Maron et al. 2012). We would argue that these biodiversity concerns have analogies on the social side, which have so far received very little attention in the literature on offsets. There is uncertainty about whether the development activities will deliver the promised benefits to local people, and there is a time lag between the conservation restrictions and when the development benefits kick in. Ideally development activities should be offered to all and should start before the enforcement of conservation restrictions, providing benefits over a range of timescales.

CONCLUSION

We have highlighted the experiences of people living alongside a biodiversity offset project in Madagascar as a mixture of the sweet and bitter: intertwined positive and negative impacts on wellbeing (with the negative currently dominant). We show that more consideration of the social impacts is a critical issue for the development of biodiversity offsets for two reasons. Firstly, this is an environmental justice issue: some of the poorest people in the world should not be made to bear the cost of allowing nationally important development while protecting biodiversity of global value. Secondly, understanding these social issues is vital to ensure the offsetting scheme can indeed deliver its promised biodiversity benefits into the long term as, unless those more affected by the restrictions are helped to new livelihoods, the land conversion and extraction will continue. As biodiversity offset projects are increasingly implemented around the world, they are becoming a new mechanism by which conservation restrictions are being imposed on rural and marginalised people, often highly

dependent on natural resources for their subsistence. More concrete actions are needed to ensure that the local costs are better balanced with tangible positive benefits.

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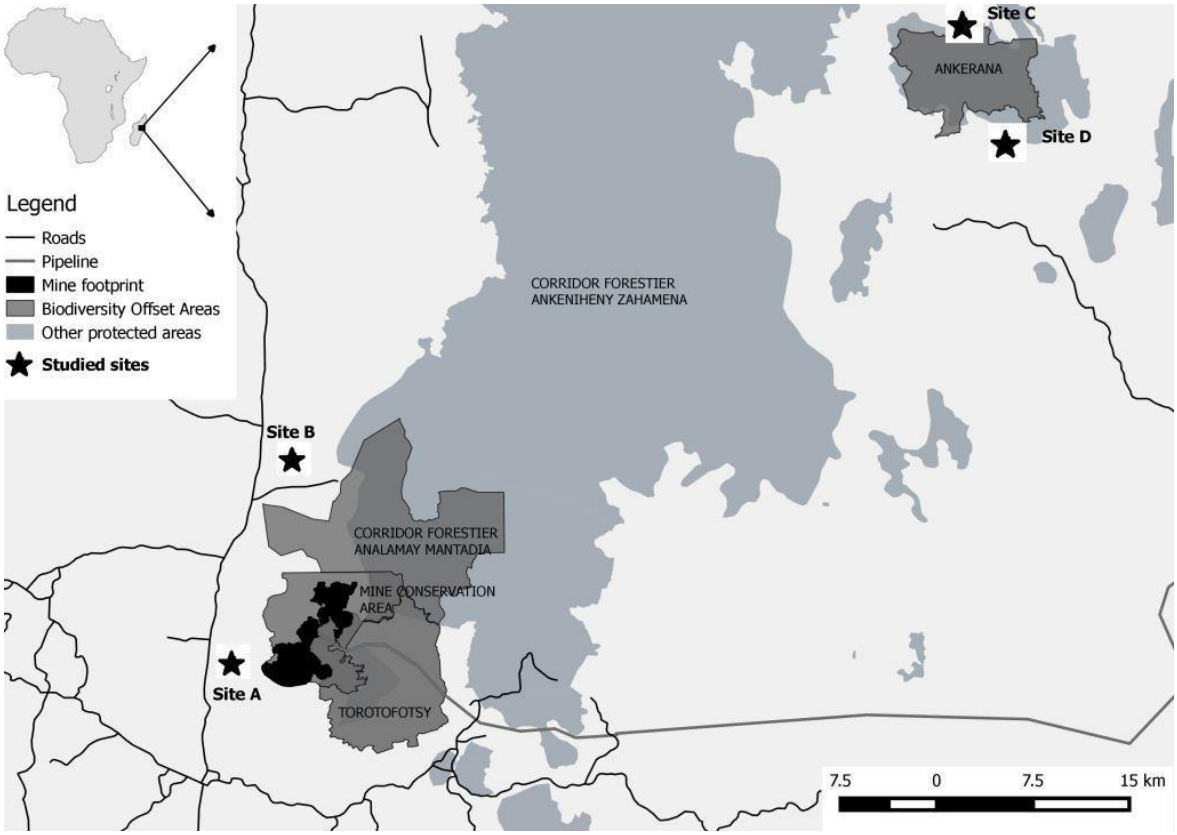

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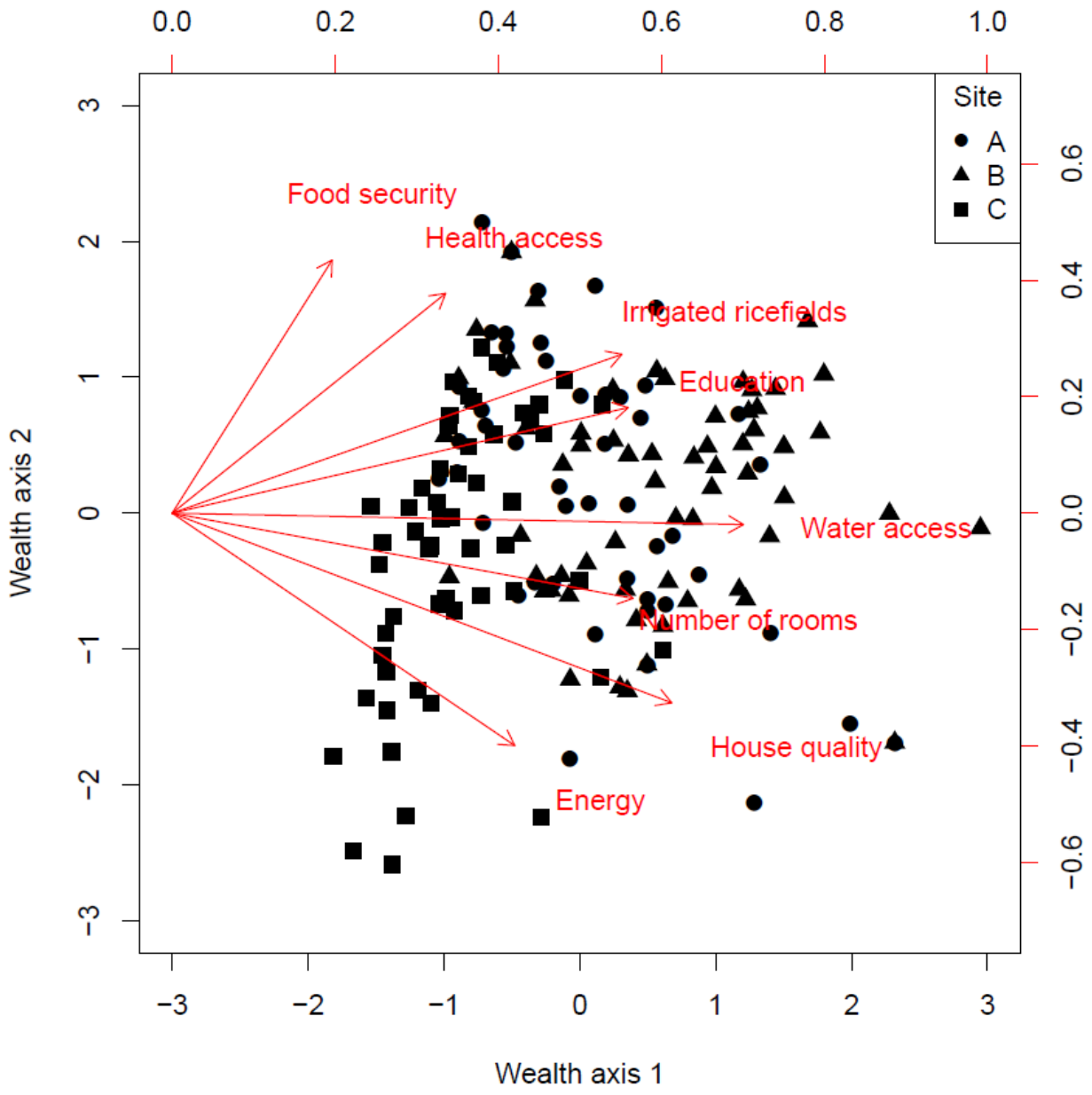

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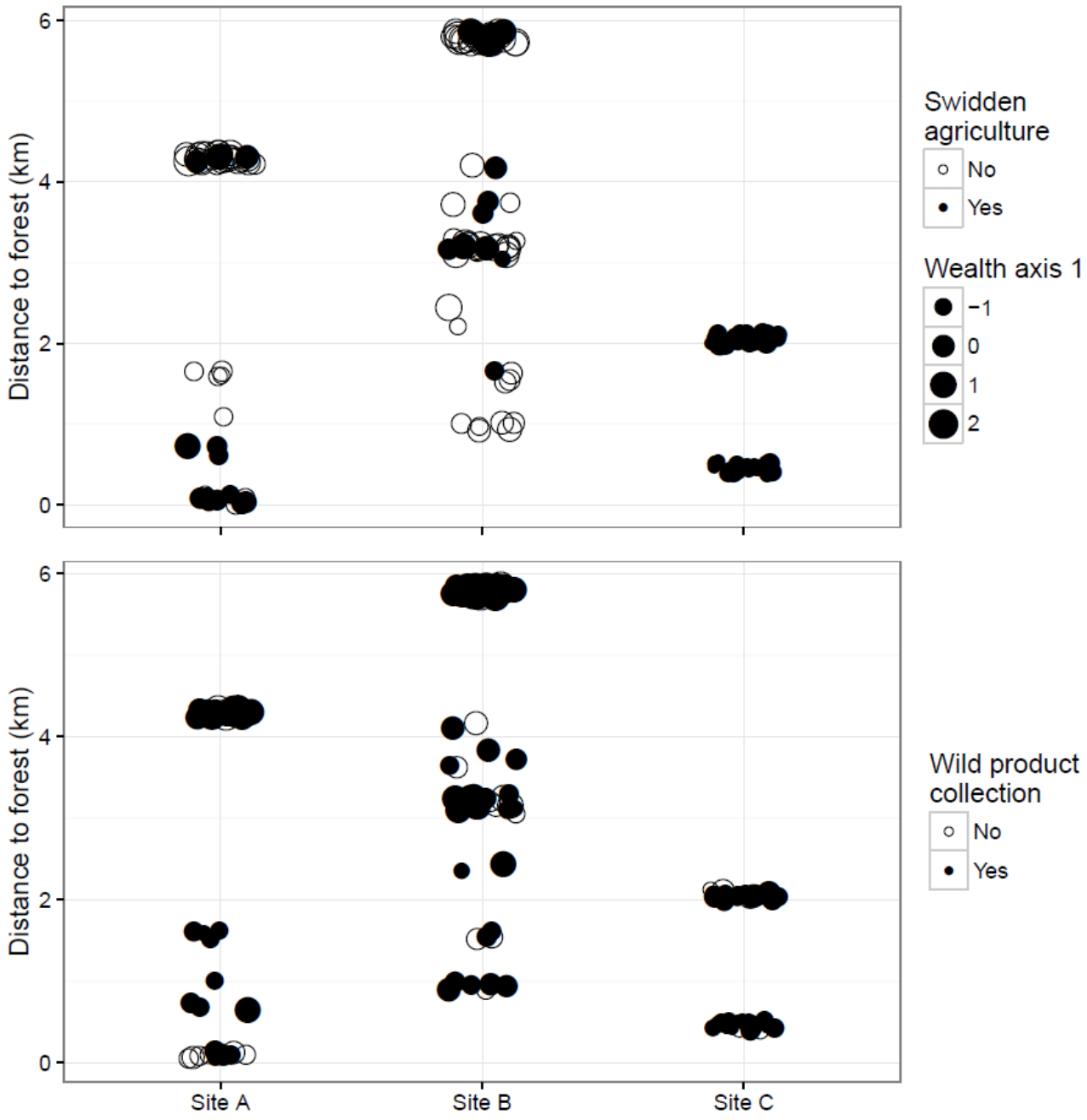

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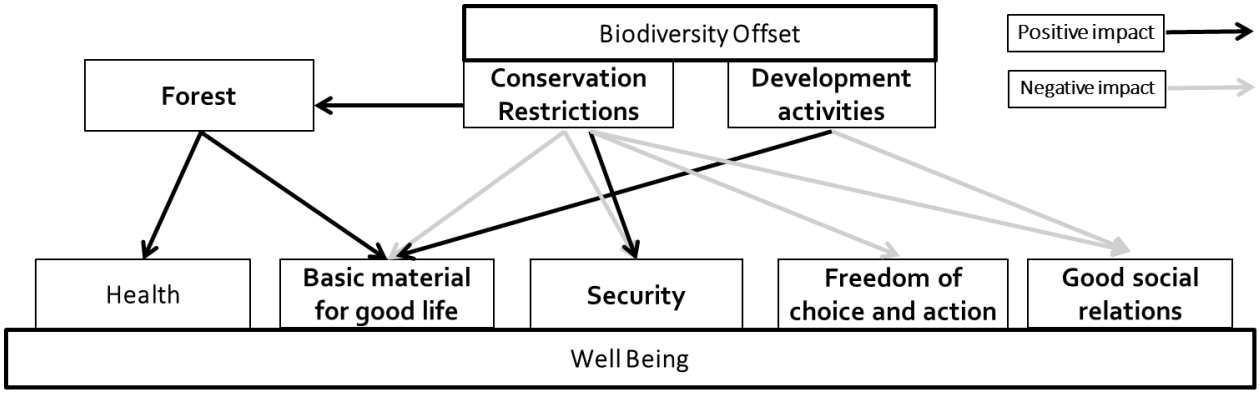

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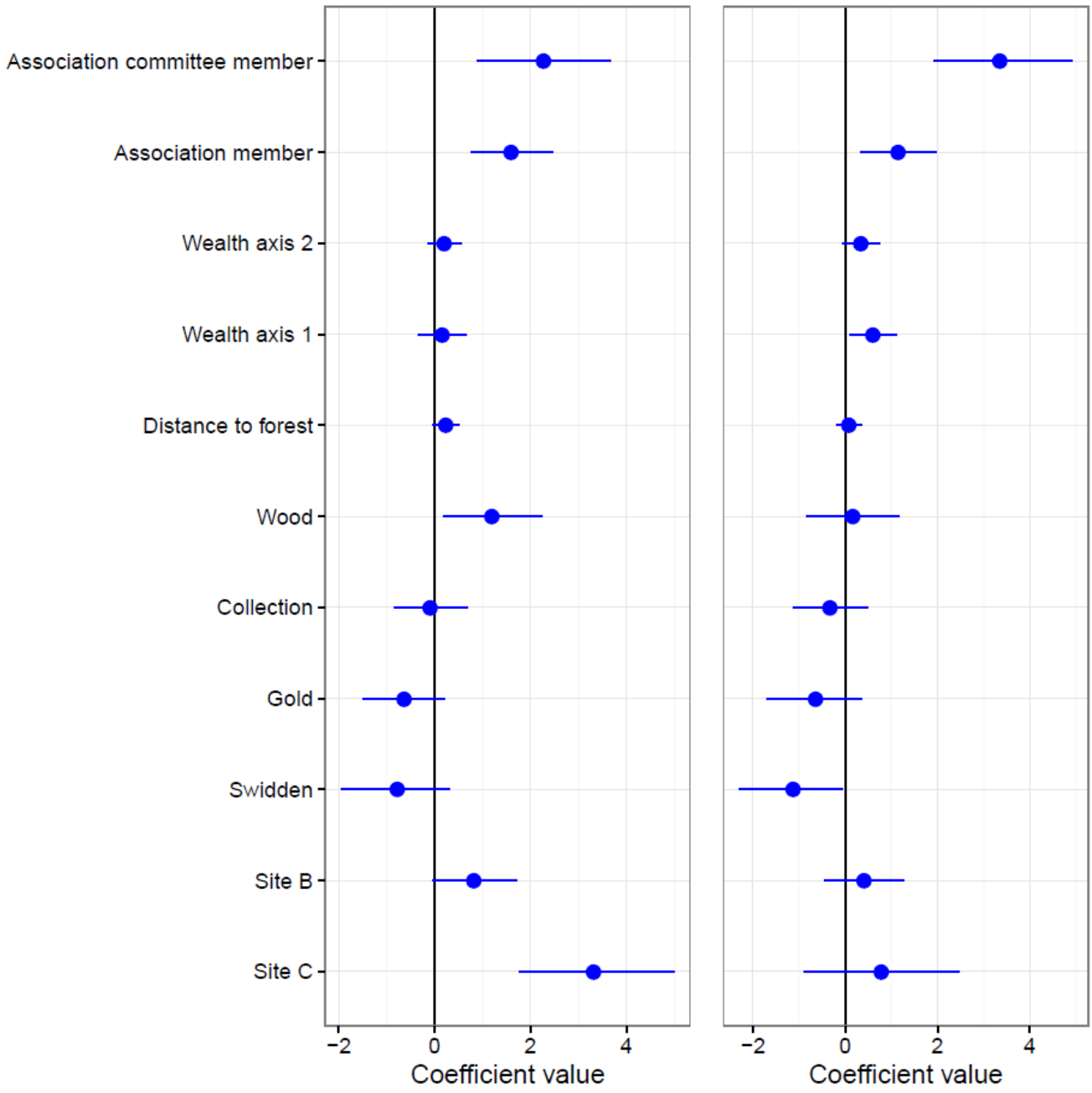

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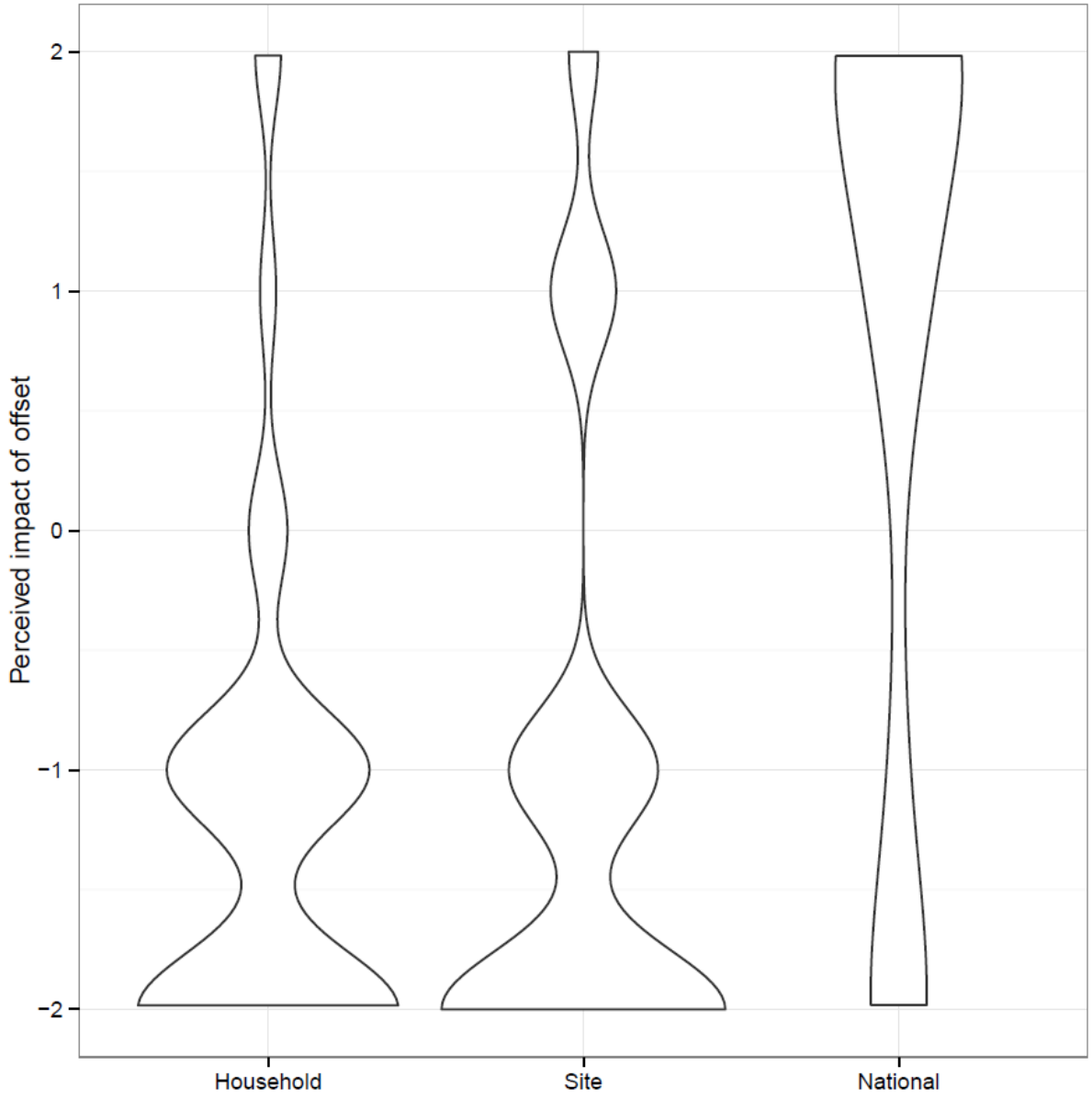

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Tables

Table 5: Numbers and location of focus groups, key informant interviews and household surveys

Site	A	B	C	D	
Commune	Ambohibary	Morarano Gara	Maroseranana	Maroseranana	Regional level
Distance to mine footprint	close (<5km) with already cleared forest	close (<5km) but forest not yet cleared	far (>50km) (Ankerana offset)	far (>50km) (Ankerana offset)	
Key informant interviews	12	9	5	4	23
Initial focus groups	4	5	4	4	1
Household surveys in *fokontany* centre	30	30	30	0	
Household surveys close to forest frontier	27	29	24	0	
Focus groups during feedback meetings	3	3	3	3	

Table 6: Indicators of Poverty used in the questionnaire

Name	Indicators	Coding	Number of levels
Education	Household head education	0=illiterate;1=primary or literate;2=secondary	3
Health access	Access to doctor and to hospital	no=0; yes=1 (for doctor) + no=0; yes=1 (for hospital)	3
Energy	Access to energy type	candle, petrol or torch=1; solar lamp=2; generator=3	3
Water access	Access to type of water	river=0; community well=1; private well=2; pump=3	4
Number rooms	Number of rooms (including bed/living rooms, kitchens, granaries)	number	10
House quality	Roof type and floor type	roof type (sheet metal=2; thatch=1) + ground type (soil or straw=1; wood=2; cement=3;)	6
Food security	Number of months of rice consumption from own production	number	12
Irrigated rice fields	Number of irrigated rice fields	number	10

Table 7: Perceived impact of material donations and training

Development activities	Total number	Number of people reached	Direct positive impact	Positive impact for future	Negative impact	No impact
Material donations	116	77	57%	28%	3%	13%
Training	100	66	45%	16%	8%	29%

Table 8: Numbers of material donations and fines among people living in the *fokontany* centre and in forest hamlets

	Number of people reached	Number of people from the village	Number of people from the forest hamlets	% of people impacted from the village	% of people impacted from the forest hamlet
Material donations	77	45	32	50%	40%
Fines	21	4	17	4%	21%

Endnotes

[1] Biodiversity offsets are discussed in the last version (2012) of the IFC Standards; however, Ambatovy developed the basic design of its offset in 2009.
[2] By decree n°20-021/05/MINENVEF
[3] Adoption of decree by the government council the 28/04/15
[4] The smallest administrative unit in Madagascar representing a few villages.
[5] http://reshare.ukdataservice.ac.uk/852341/
[6] There are different types of *tavy*: the term includes swidden cultivation in fallow and clearing land from primary forest (sometimes called '*teviala*').
[7] "*izay akaiky vilany feno arina*" In the context of this comment, soot is not seen as a bad thing but as demonstrating you are close to the cooking pot and so able to benefit from food and heat more easily.
[8]*sahala amin'ny vozon'akoho, atelina toa misy taolona, tsy hoanina toa misy nofiny*
[9]*Papango nahazo sokatra, nahazo fa tsy loatra*